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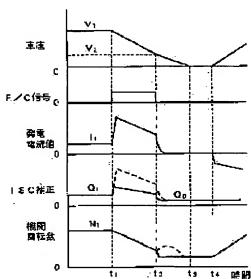
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# (54) VEHICLE WITH MODIFIED ENGINE OUTPUT CONTROL CHARACTERISTIC DURING REGENERATIVE POWER GENERATION

### (57)Abstract:

PROBLEM TO BE SOLVED: To prevent an engine rotation racing phenomenon in the case that regenerative power generation is performed and finished when a vehicle decelerates under fuel-cut or travels under braking, in the vehicle in which when a capacitor is to be charged a part of output of an internal combustion engine is distributed to drive power generating means, and control is executed that output of the internal combustion engine is increased in response to the power generation of the power generating means. SOLUTION: When the vehicle decelerates under fuel-cut or travels under braking and regenerative power generation is performed, control characteristic to additionally increase the output of the internal combustion engine in response to power generation is modified so as to relatively reduce engine additional output compared to power generation.



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#### **CLAIMS**

# [Claim(s)]

[Claim 1] An internal combustion engine, a generation—of—electrical—energy means, an electric means, and an engine output main control means to control said internal combustion engine's output reflecting an operation intention of an operator, The engine output auxiliary control means which controls said internal combustion engine's additional output according to the amount of generations of electrical energy of said generation—of—electrical—energy means, When making it the vehicle equipped with the generation—of—electrical—energy control means which controls the generation of electrical energy by said generation—of—electrical—energy means and carrying out the generation of electrical energy said whose generation—of—electrical—energy control means the supply of a fuel to said internal combustion engine is intercepted, and collects the kinetic energy of a vehicle for said generation—of—electrical—energy means, The vehicle characterized by having an engine output—control correction means to correct the property of the engine addition output control according to the amount of generations of electrical energy of said engine output auxiliary control means so that an engine addition output may become small relatively as contrasted with the amount of generations of electrical energy.

[Claim 2] The correction which said engine output auxiliary control means is a means to control for idle operation of said internal combustion engine's output, and makes an engine addition output small relatively with said engine output—control correction means as contrasted with the amount of generations of electrical energy is a vehicle according to claim 1 characterized by supposing that it is so loose that it is low according to the travel speed of a vehicle.

[Claim 3] The correction which said engine output auxiliary control means is a means to control for idle operation of said internal combustion engine's output, and makes an engine addition

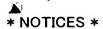
output small relatively with said engine output—control correction means as contrasted with the amount of generations of electrical energy is a vehicle according to claim 1 or 2 characterized by supposing that it is so loose that it is large according to the deceleration of a vehicle.

[Claim 4] The correction which said engine output auxiliary control means is a means to control for idle operation of said internal combustion engine's output, and makes an engine addition

for idle operation of said internal combustion engine's output, and makes an engine addition output small relatively with said engine output-control correction means as contrasted with the amount of generations of electrical energy is a vehicle given in either of claims 1, 2, or 3 characterized by supposing that it is so loose that it is low according to whenever [ engine cooling water temperature ].

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### **DETAILED DESCRIPTION**

[Detailed Description of the Invention] [0001]

[Field of the Invention] This invention relates to an internal combustion engine's output control in a vehicle, especially relates to an internal combustion engine's output control in the vehicle [ as / in a hybrid car ] which performs a part of vehicle drive electrically.
[0002]

[Description of the Prior Art] In the vehicle [ as / in a hybrid car ] which performs a part of vehicle drive electrically, charge of accumulation—of—electricity equipment equipped with an appropriate capacity is performed during operation of a vehicle. In this case, although carried out by increasing it according to whenever [ charge / of accumulation—of—electricity equipment ] (State of Charge, omitting SOC) more than a vehicle drive takes an internal combustion engine's output suitably to charge, and driving a generation—of—electrical—energy means, at the time of moderation of a vehicle or braking, a generation—of—electrical—energy means is driven using the kinetic energy of a vehicle, and cutting down consumption of a fuel is also performed. Although the generation of electrical energy of this latter is called the regeneration generation of electrical energy, the so—called fuel cut which generally intercepts the supply of a fuel to an internal combustion engine is performed during this regeneration generation of electrical energy. When the field of the fuel cut at the time of a regeneration generation of electrical energy is further expanded to JP,2000—287304,A about this point and an engine falls to idle rpm, stabilizing engine operation at the time of fuel cut termination is proposed by assisting rotation of an engine with a motor.

[0003] Moreover, in many cases, output increase of the internal combustion engine for charge of accumulation-of-electricity equipment is performed by the idle revolving-speed-control equipment (Idle Speed Control, omitting ISC) which is an output-control means for engine idle operation.

[0004]

[Problem(s) to be Solved by the Invention] When accumulation—of—electricity equipment should be charged, distribute a part of an internal combustion engine's output to a generation—of—electrical—energy means, and this is driven. In the vehicle with which control which increases an internal combustion engine's output corresponding to the amount of generations of electrical energy of a generation—of—electrical—energy means in that case is performed Also when the regeneration generation of electrical energy which drives a generation—of—electrical—energy means using the kinetic energy of a vehicle at the time of moderation of a vehicle or braking was performed conventionally, it had become performing control which increases an engine output corresponding to the control means which controls an internal combustion engine's output especially above—mentioned ISC, \*\*, and the amount of generations of electrical energy as it is as predetermined. In the vehicle general in recent years which the supply of a fuel to an internal combustion engine calculates this based on the amount of supply of inhalation of air, and is controlled by the fuel injection equipment based on the result of an operation It is because the fuel was not supplied anyway during the fuel cut, so the slip engine performance of the engine under fuel cut hardly changed even if the amount of supply of inhalation of air was increasing

somewhat corresponding to the amount of generations of electrical energy, therefore it was thought that the inhalation-of-air control corresponding to a fuel cut was unnecessary. [0005] However, when moderation or braking of a vehicle is completed, a fuel cut is canceled and the load of a regeneration generation of electrical energy is canceled by it and coincidence, there is a time lag with the amount of supply of the inhalation of air which was increasing corresponding to the amount of generations of electrical energy remarkable for decreasing corresponding to discharge of a regeneration generation-of-electrical-energy load. Although the phenomenon slightly sent out by the internal combustion engine immediately after fuel cut discharge was conventionally seen in this vehicle, it is thought that the cause is in the delay of the above-mentioned inhalation-of-air flow rate return.

[0006] This invention is made into the offering-vehicle by which way amelioration was carried out so that such internal combustion engine might blow and riser might not arise paying attention to internal combustion engine \*\*\*\* riser by above-mentioned cause produced on this kind of vehicle technical problem.

# [0007]

[Means for Solving the Problem] This invention as what solves the above-mentioned technical problem An internal combustion engine and a generation-of-electrical-energy means, An electric means and an engine output main control means to control said internal combustion engine's output reflecting an operation intention of an operator, The engine output auxiliary control means which controls said internal combustion engine's additional output according to the amount of generations of electrical energy of said generation-of-electrical-energy means, When making it the vehicle equipped with the generation-of-electrical-energy control means which controls the generation of electrical energy by said generation-of-electrical-energy means and carrying out the generation of electrical energy said whose generation-of-electrical-energy control means the supply of a fuel to said internal combustion engine is intercepted, and collects the kinetic energy of a vehicle for said generation-of-electrical-energy means, The vehicle characterized by having an engine output-control correction means to correct the property of the engine addition output control according to the amount of generations of electrical energy of said engine output auxiliary control means so that an engine addition output may become small relatively as contrasted with the amount of generations of electrical energy is offered.

[0008] When it is a means to control for said engine output auxiliary control means's idle operation of an internal combustion engine's output, the correction which makes an engine addition output small relatively with said engine output-control correction means as contrasted with the amount of generations of electrical energy may be made so loose that it is low according to the travel speed of a vehicle.

[0009] Moreover, when said engine output auxiliary control means is a means to control for idle operation of an internal combustion engine's output, the correction which makes an engine addition output small relatively with said engine output-control correction means as contrasted with the amount of generations of electrical energy may be made so loose that it is large according to the deceleration of a vehicle.

[0010] Moreover, when said engine output auxiliary control means is a means to control for idle operation of an internal combustion engine's output, the correction which makes an engine addition output small relatively as contrasted with the amount of generations of electrical energy by said engine output-control correction means may be made so loose that it is low according to an internal combustion engine's circulating water temperature.

[0011] [Function and Effect of the Invention] An engine output main control means to control an internal combustion engine's output reflecting [ like / the above ] an internal combustion engine, a generation-of-electrical-energy means, an electric means, and an operation intention of an operator, The engine output auxiliary control means which controls an internal combustion engine's additional output according to the amount of generations of electrical energy of a generation-of-electrical-energy means, When carrying out the generation of electrical energy whose generation-of-electrical-energy control means the supply of a fuel to an internal combustion engine is intercepted, and collects the kinetic energy of a vehicle for a generationof-electrical-energy means in the vehicle equipped with the generation-of-electrical-energy control means which controls the generation of electrical energy by the generation-of-electrical-energy means, If an engine output-control correction means to correct the property of the engine addition output control according to the amount of generations of electrical energy of an engine output auxiliary control means so that an engine addition output may become small relatively as contrasted with the amount of generations of electrical energy is established Since it changes the additional output control of the internal combustion engine according to the amount of generations of electrical energy by the engine output auxiliary control means into the condition of having decreased beforehand when cutoff of the supply of a fuel to an internal combustion engine is canceled and the regeneration generation-of-electrical-energy load to a generation-of-electrical-energy means is canceled by it and coincidence It is avoided that blow on an internal combustion engine and a riser arises.

[0012] The end in the condition of carrying out the generation of electrical energy whose generation-of-electrical-energy control means a vehicle is moderation or braking running, the supply of a fuel to an internal combustion engine is intercepted, and collects the kinetic energy of a vehicle for a generation-of-electrical-energy means is usually idle operation for an internal combustion engine. In this case, when it is a means to control for an engine output auxiliary control means's idle operation of an internal combustion engine's output, an idle setup of an internal combustion engine in the end of the above-mentioned condition becomes so high that the degree of the correction which makes an engine output small relatively as contrasted with the amount of generations of electrical energy performed by the engine output-control correction means is loose.

[0013] To raise idle rpm is desired, so that the travel speed of a vehicle is low, in order to be stabilized and to secure idle operation of an engine, since the degree by which engine rotation is rescued from a wheel side falls if the travel speed of a vehicle kicks low. Therefore, if whenever [relative engine output reduction] is made so loose that the transit vehicle speed is low according to the travel speed of a vehicle when the correction which makes an engine output small relatively with an engine output—control correction means as contrasted with the amount of generations of electrical energy is made, it will be avoided certainly that an engine failure arises in an internal combustion engine by this control.

[0014] Since similarly possibility that an engine failure will arise in the end of moderation or braking becomes high so that deceleration is large when a vehicle is slowed down or braked When it is a means to control for an engine output auxiliary control means's idle operation of an internal combustion engine's output If the correction which makes an engine output small relatively with an engine output—control correction means as contrasted with the amount of generations of electrical energy is made so loose that it is large according to the deceleration of a vehicle, it will be avoided certainly that an engine failure arises by this control.

[0015] Since similarly possibility that an engine failure will arise in the end of moderation or braking becomes high so that whenever [ warming-up / of an engine ], i.e., the temperature of engine cooling water, is low when a vehicle is slowed down or braked When it is a means to control for an engine output auxiliary control means's idle operation of an internal combustion engine's output If the correction which makes an engine output small relatively with an engine output-control correction means as contrasted with the amount of generations of electrical energy is made so loose that it is low according to whenever [ engine cooling water temperature ], it will be avoided certainly that an engine failure arises by this control. [0016]

[Embodiment of the Invention] Attached <u>drawing 1</u> and attached <u>drawing 2</u> are the schematic diagram showing two examples of the drive structure of a high Brit vehicle. In these drawings, 1 and 101 are internal combustion engines, respectively, and 2 and 102 are the driving wheels of a pair, respectively.

[0017] In the drive structure of <u>drawing 1</u>, an internal combustion engine's crankshaft (not shown) is connected with the driving wheel 2 of a pair through the change gear 3, the motor generator (motor generator) 4, and the differential gear mechanism 5. In addition, since intermediate shank material is obvious, it omits explanation. A motor generator 4 is the thing of

an alternating current specification, and is electrically connected with accumulation-of-electricity equipment 7 through the inverter 6 which performs conversion between an alternating current and a direct current.

[0018] In the drive structure of drawing 2, an internal combustion engine's crankshaft (not shown) is connected with a generator 104 and the dynamo-electric means (here, a motor is called once) 105 which operate also as a generator although operated mainly as a motor through the power transfer 103 which consists of an epicyclic gear device. Power transfer 103 is connected with an internal combustion engine's crankshaft on the carrier of an epicyclic gear device, is connected with a generator 104 with a sun gear, is connected with a motor 105 in a device, is connected with the driving wheel 102 of a pair through the differential gear ring wheel, and is connected with the driving wheel 102 of a pair through the connection mechanism 107 which gets into gear to the gearing 106 further prepared there in the connection section with a motor 105, and it. Since intermediate shank material is obvious, it omits explanation also here. A generator 104 and a motor 105 are also the things of an alternating current specification, and are electrically connected with accumulation-of-electricity equipment 109 through the inverter 108.

[0019] In the drive structure of drawing 1, actuation of the internal combustion machine 1, a change gear 3, and a motor generator 4 is controlled by the vehicle control device 8. The vehicle control device 8 is equipped with a microcomputer, control count is performed based on the various information about the operation condition of a control program and a vehicle incorporated there, the various starting devices of vehicles including an internal combustion engine are controlled based on it, and the fundamental configuration is a well-known thing already. As far as this invention is concerned, to the vehicle control device 8 The signal which shows the intention of the operator about an engine output from an accelerator pedal, the signal which shows the intention of the operator about braking of a vehicle from a brake pedal, The signal concerning an engine rotational frequency from an engine rotational frequency sensor, the signal which shows the vehicle speed from a speed sensor, The signal which shows the acceleration (the case of a negative value deceleration) of a vehicle from an acceleration sensor, the signal which shows the temperature of internal combustion engine cooling water from a cooling coolant temperature sensor, and the signal which shows the charge condition of accumulation-of-electricity equipment from accumulation-of-electricity equipment 7 are supplied. The vehicle control device 8 performs a control operation based on these signals, operates the inhalation-of-air collimator 9 and a fuel injection equipment 10, and controls an engine output. When the gear ratio of a change gear 3 is switched, and a vehicle is in the vehicle speed beyond a predetermined value and it is under moderation or braking, Increase the generation-of-electrical-energy load of a generator motor, the regeneration generation of electrical energy which collects the kinetic energy of a vehicle as electrical energy is made to perform, and control actuation which charges the generated power at accumulation-ofelectricity equipment is performed at the same time it performs a fuel cut. [0020] Similarly, in the drive structure of  $\underline{\text{drawing 2}}$ , actuation of the internal combustion machine 101, a change gear 103, a generator 104, and a motor 105 is controlled by the vehicle control device 110. It has a microcomputer like [ the vehicle control device 110 ] the vehicle control device 8 of drawing 1 . They are the control program incorporated there and the thing which performs a control operation based on the various information about the operation condition of a vehicle. An accelerator pedal, a brake pedal, an engine rotational frequency sensor, a speed sensor, When a signal is supplied from an acceleration sensor, a cooling coolant temperature sensor, and accumulation-of-electricity equipment 109, the inhalation-of-air collimator 111 and a fuel injection equipment 112 are operated, an engine output is controlled based on these signals and a vehicle is braking [ moderation or ], Increase the generation-ofelectrical-energy load of a generation-of-electrical-energy means, the regeneration generation of electrical energy which collects the kinetic energy of a vehicle as electrical energy is made to perform, and control actuation which charges it at accumulation-of-electricity equipment is performed at the same time it performs a fuel cut. In addition, in the drive structure of drawing 2, as a generation-of-electrical-energy means to charge this based on the accumulation-ofelectricity condition (SOC) of accumulation-of-electricity equipment 109, a generator 104

operates chiefly, and a motor 105 operates in generation-of-electrical-energy mode chiefly as a generation-of-electrical-energy means to collect the kinetic energy of a vehicle as electrical energy at the time of moderation of a vehicle or braking. Moreover, at the time of usual operation of a vehicle, from an internal combustion engine, the power transfer 103 which consists of an epicyclic gear device, and a generator 104 perform adjustment between the torque of the power transmitted to a wheel, and a rotational frequency, and achieve the function of a change gear. [0021] Drawing 3 is a graph with which the drive structure of a hybrid car as shown in drawing 1 or drawing 2 shows the mode controlled by each vehicle control device 8 or 110 according to this invention at the time of moderation of a vehicle or braking transit.

[0022] Now, with the fixed vehicle speed V1, a vehicle does not perform a fuel cut but generates the fixed current value which becomes current value I1. The auxiliary control of the internal combustion engine is carried out so that the additional engine output of an amount may be generated. a part for the power consumed to a generation of electrical energy corresponding to it — it should compensate — an idle control device (ISC) — Q1 — running in the condition that the engine is rotating at the fixed rotational frequency N1 — carrying out — from this condition — starting — Time t — suppose that moderation of a vehicle started in 1, the fuel cut was started, and the regeneration generation of electrical energy which collects the kinetic energy of a vehicle as electrical energy was started. While running with the vehicle speed beyond a predetermined value with a vehicle, the condition that treading in of an accelerator pedal is canceled suddenly, or the brake pedal was stepped on further in addition to this corresponds to this.

[0023] The supply of a fuel to an internal combustion engine is intercepted by dispatch of a fuel cut (F/C) signal, and by change in increase of the generation-of-electrical-energy capacity of a generator 6, or the generation-of-electrical-energy mode of a motor 105, like illustration, a generation-of-electrical-energy current once increases rapidly, and falls gradually like illustration with the fall of the vehicle speed and an engine rotational frequency after that. According to dynamo-engine output amendment control according to conventional ISC at this time, although it is carried out so that inspired air volume may be increased corresponding to increase of a generation-of-electrical-energy current value as ISC amendment is shown by the drawing destructive line when the amount of generations of electrical energy increases, according to this invention, it replaces with ISC amendment like a broken line, and correction which makes small the amount of inhalation-of-air amendments as contrasted with a generation-of-electricalenergy current value so that according to a continuous line is made. In addition, although ISC amendment may be set to 0 as control at this time, since inlet-pipe negative pressure increases by closing an inhalation-of-air control valve during moderation or braking in fact, the amount of inhalation-of-air amendments by ISC once increases from Q1 for a time, as shown in the continuous line of drawing 3.

[0024] In this way, by being controlled as shown by the drawing solid line from the increase amendment of the \*\*\*\* former ISC amendment is indicated to be by the drawing destructive line during the fuel cut Time t — when the vehicle speed fell to V2 in 2, a fuel cut was stopped, and the generation—of—electrical—energy load for regeneration of a generator motor 6 was canceled or actuation by the generation—of—electrical—energy mode of a motor 105 was canceled, as a broken line showed an engine rotational frequency, it was generated conventionally — blowing up — it is avoided, in addition — the example of illustration — Time t — the generation of electrical energy of a current value I1 currently performed to 1 — Time t — it is stopped in 1, and the ISC amendment to it is also suspended at a coincidence point, and ISC amendment serves as the amount Q0 of amendments which maintains only idle operation, then, the time t — a vehicle stops in 3, and an engine is maintained by idle operational status and starts vehicle drive operation again in t4 after that further at the time. When the current of accumulation—of—electricity equipment is consumed for vehicle start at this time, as a generation—of—electrical—energy current value, it becomes a negative value.

[0025] In the generation of electrical energy performed based on the charge condition of accumulation-of-electricity equipment, ISC amendment is performed so that it may increase according to increase of a generation-of-electrical-energy current value, as shown to drawing 4

by the broken line. The value in [ Q0 ] drawing is the amount of basic ISC amendments in case a generation-of-electrical-energy current value is 0, and this is the inhalation-of-air amount of supply by ISC when maintaining idle operation in the condition of not generating electricity. On the other hand, as a drawing solid line shows the correction to moderation of the fuel cut by this invention, or the ISC amendment under braking as one example, ISC amendment may be uniformly maintained to the value of Q0 irrespective of a generation-of-electrical-energy current value. However, since inlet-pipe negative pressure increases like \*\*\*\* by closing an inhalationof-air control valve during moderation or braking in fact, the amount of inhalation-of-air amendments by ISC increases for a time, as shown in the continuous line of  $\frac{drawing 3}{drawing 3}$ . [0026] However, since ISC amendment is not increasing like before when fuel cut moderation or braking is completed if the ISC amendment under fuel cut moderation or braking is corrected so that it may be maintained by the above-mentioned value like Q0, depending on the case, rotation of an engine becomes unstable, and there is a possibility that an engine failure may happen. The degree to which the engine rotation in this case becomes unstable increases from the degree by which engine rotation is rescued from a wheel side falling, so that the travel speed of a vehicle is low. Then, as an adjusted value Q of the ISC amendment under fuel cut moderation or braking, Q may be corrected like alphaQ0 using the multiplier alpha which increases according to the fall of

[0027] Furthermore, when fuel cut moderation or braking is completed again by making the reduction correction of the ISC amendment under fuel cut moderation or braking, rotation of an engine becomes unstable, and a possibility that an engine failure may happen increases, so that the deceleration of a vehicle is large. Then, as an adjusted value Q of the ISC amendment under fuel cut moderation or braking, Q may be corrected like betaQ0 or \*\*\*\*Q0 using the multiplier fuel cut moderation or braking, Q may be corrected like betaQ0 or \*\*\*\*Q0 using the multiplier beta which increases according to decelerating increase as shown in drawing 6.

[0028] Furthermore, when fuel cut moderation or braking is completed again by making the reduction correction of the ISC amendment under fuel cut moderation or braking, rotation of an engine becomes unstable and the time when whenever [ warming-up / of an engine ] is lower as engine becomes unstable and the time when whenever [ warming-up / of an engine ] is lower as for a possibility that an engine failure may happen increases. Then, as a value Q with which the ISC amendment under fuel cut moderation or braking was corrected, Q may be corrected using ISC amendment under fuel cut moderation or braking was corrected, Q may be corrected using the multiplier gamma which increases according to the fall of whenever [ engine cooling water the multiplier gamma which increases according to the fall of whenever [ engine cooling water the multiplier gamma Q0, alphagammaQ0 and betagammaQ0, or \*\*\*\*gammaQ0 as shown in drawing 7.

[0029] Although this invention was explained above about some examples at the detail, probably, it will be clear for this contractor for various corrections to be possible within the limits of this invention about these examples.

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### **DESCRIPTION OF DRAWINGS**

[Brief Description of the Drawings]

[Drawing 1] Yes, the schematic diagram showing one example of the drive structure of a Brit vehicle.

[Drawing 2] Yes, the schematic diagram showing other one example of the drive structure of a Brit vehicle.

[Drawing 3] The graph with which the drive structure of a hybrid car as shown in drawing 1 or 2 shows the mode controlled by the vehicle control device according to this invention at the time of moderation of a vehicle or braking transit.

[Drawing 4] The map in which an example of the value of ISC amendment to a generation-of-electrical-energy current value is shown.

[Drawing 5] The map in which an example of the correction factor which corrects the value of ISC amendment to the travel speed of a vehicle is shown.

[Drawing 6] The map in which an example of the correction factor which corrects the value of ISC amendment to the deceleration of a vehicle is shown.

[Drawing 7] The map in which an example of the correction factor which corrects the value of ISC amendment to whenever [ engine cooling water temperature / of a vehicle ] is shown.

[Description of Notations]

- 1,101 -- Internal combustion engine
- 2,102 -- Wheel
- 3 -- Change gear
- 4 -- Motor generator
- 5,107 -- Differential gear mechanism
- 6,108 -- Inverter
- 7,109 -- Accumulation-of-electricity equipment
- 8,110 -- Vehicle control device
- 9,111 -- Inhalation-of-air collimator
- 10,112 Fuel injection equipment
- 103 -- Power transfer
- 104 -- Generator
- 105 -- Motor
- 106 -- Gearing

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